

WEEKEND PROJECTS

GOT A GAP IN THE DIARY?

FILL IT WITH AN AWESOME RASPBERRY PI PROJECT.

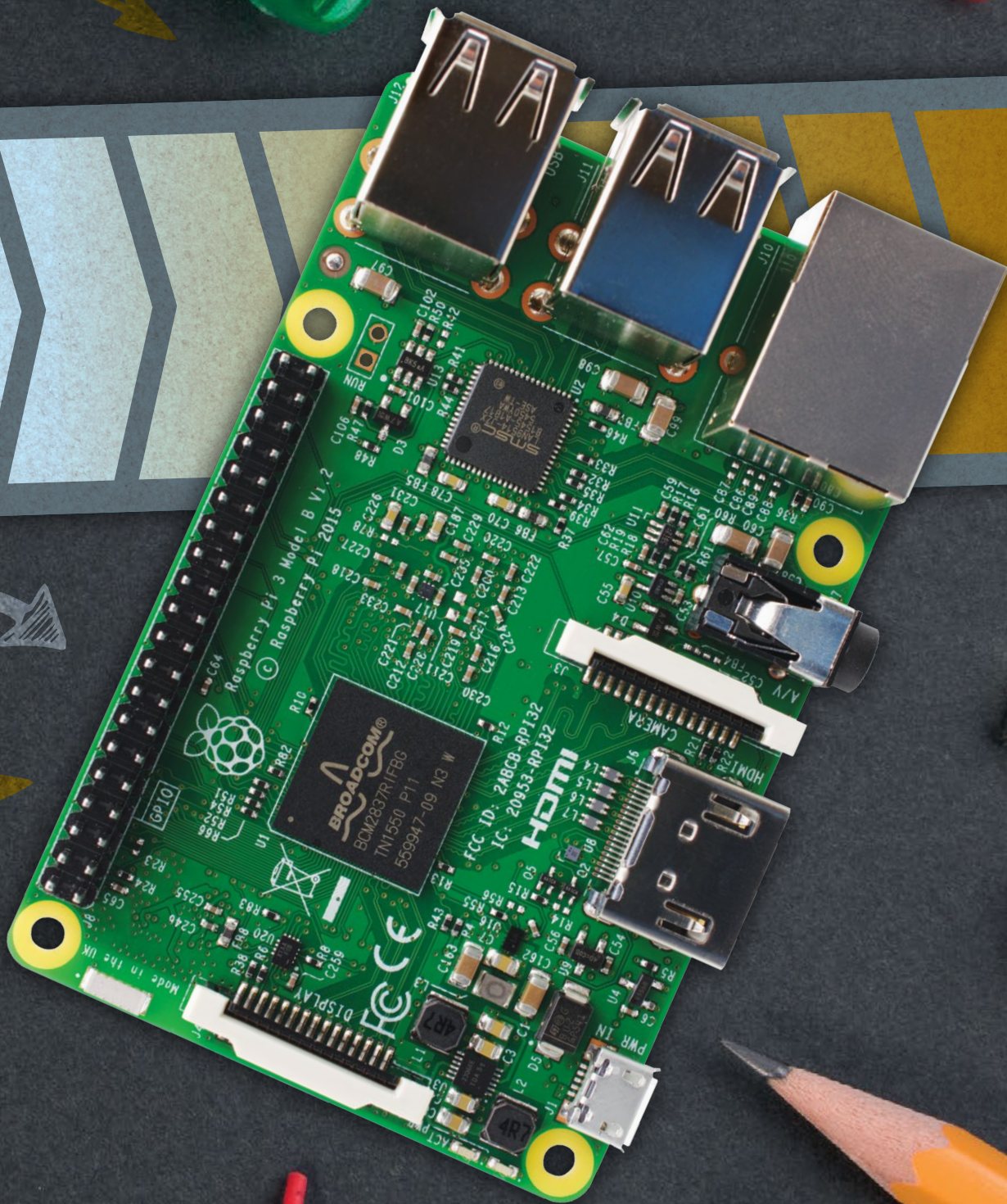
What will you say when your friends and colleagues ask you what you did at the weekend? Watched a film, went out for lunch, or had a lie-in?

Give them a better answer: in this project roundup we show you what you can achieve in two days. You could build a robot, upgrade your family's toys, or fashion a sparkling bag. You could connect your fridge to the Internet of Things, or hack a stereo to play your theme song when you walk into the room.

Many of the projects are family-friendly, so younger makers can join in. Let's get started!

LET'S GET
MAKING!

Grab your tools, toys
and Pis, and make
something amazing this
weekend!



MAKE A SMART FRIDGE

DO YOU NEED TO BUY MORE BEER, OR IS SOMEONE AT HOME STEALING YOURS? LET YOUR FRIDGE TELL YOU, USING A WEB DASHBOARD.



JAMIE BAILEY

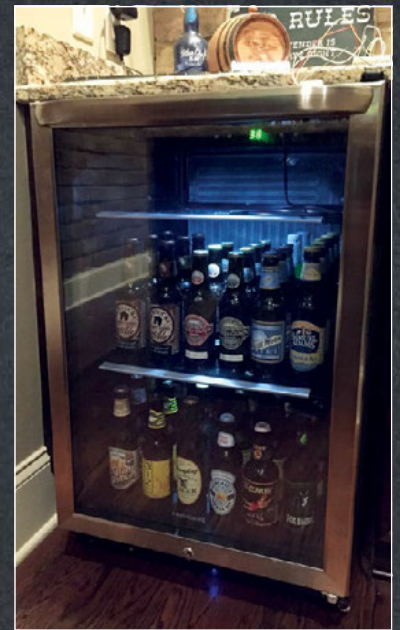
Jamie is the CEO and founder of Initial State. He has 16 years of experience in product development, integrated circuit (IC) design and testing, embedded systems, and software development. magpi.cc/2xyo28v

Here's a cool project: a drinks fridge that uses a scale to work out how many bottles are inside, a temperature sensor to help you keep the beers chilled, and another sensor to detect when the door is opened. The data can all be streamed to a web-based dashboard.

Jamie Bailey conceived the project as a way to stop his house-sitting 19-year-old nephew from stealing his beer. Now, if a bottle is removed from the fridge, Jamie gets a text message and can call his nephew to warn him off before the bottle is even opened.

"I decided early on that a web-connected scale was going to be an effective, non-intrusive way to make my beer fridge 'smart'," Jamie says. "I didn't want to drill any holes in my fridge or worry about communicating with electronics from inside a closed, cold box. Finding a web-connected scale was frustrating because there really weren't any products on the market that I could use. Once I figured out that I could hack a Wii Balance Board to talk to a Pi, the project was truly a go."

The Balance Board sits underneath the fridge and connects to the Pi over Bluetooth. By knowing the weight of the fridge and the weight of a bottle, Jamie's Python code can work



out how many bottles are inside the fridge.

Data is streamed to a dashboard designed by Initial State, the company Jamie founded, which provides graphs and the ability to trigger a text message alert.

"It was so cool to take something that I already had and turn it into a data collecting, peace-of-mind appliance that no one else in the world had," Jamie says. "It has been such an awesome conversation piece when friends and family come over."

Visit the link for a detailed guide, including the code to create your own smart fridge. Cheers!

MAKE YOUR FRIDGE SMART

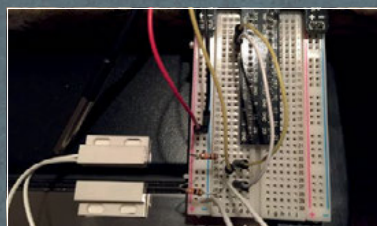
ADD THE SCALES

You can't pair the Balance Board with the Pi permanently. Use a pencil as a lever so you can press the sync button, even with the fridge on top.



ADD THE SENSORS

The magnetic contact door sensor connects to the Pi through a breadboard, with a 10 kΩ resistor. The temperature sensor sits inside the fridge, with the wires running through the door seal.



STREAM DATA

You can stream data to an Initial State dashboard in JSON format or with URL parameters. Download Jamie's code to test your sensors and set up your fridge.



TALKIEPI

DO YOU WANT TO MAKE INTERNET-CONNECTED WALKIE-TALKIES FOR ALL THE FAMILY? THAT'S A BIG TEN-FOUR!

Watching Netflix series *Stranger Things* inspired Daniel Chote to make some “big ol’ 1980s walkie-talkies” for his family. His children Eddie (6) and Ollie (3) can use them to chat to each other, and to their friends, through an internet-based server.

The software core is Mumble, an open-source voice chat system designed for use by PC gamers. There are clients for a range of operating systems, so the TalkiePi, as Daniel has named his project, is compatible with many other apps and devices. The software can be used to connect groups of people who can chat to each other, like using channels on a traditional walkie-talkie.

Daniel used a US Robotics USB Speakerphone, which sells for less than \$12, as the heart of his device. He removed its case and connected its board to one of the Raspberry Pi 3's USB ports.

He wired up some simple components to the Pi's GPIO pins:

a push-button to use when talking, and two status LEDs at the bottom of the speaker. One is illuminated when you're connected to the Mumble server, and the second lights up when other people are in the chat room. A third LED inside the button lights up when the TalkiePi is sending your audio.

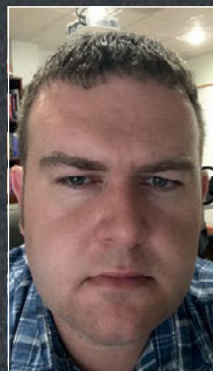
Daniel designed a case to house the device using Autodesk's 3D CAD software Fusion 360. The case was printed using a Monoprice Select Mini 3D printer.

For now, the device is powered using a wall socket, but possible enhancements include portable power.

You can find Daniel's code and 3D-printable design files at magpi.cc/2vKbHP3.

Daniel's advice to other makers? “Keep it simple – be creative,” he says. “Don't be afraid to learn new programming languages, or even something like Fusion 360 for CAD.”

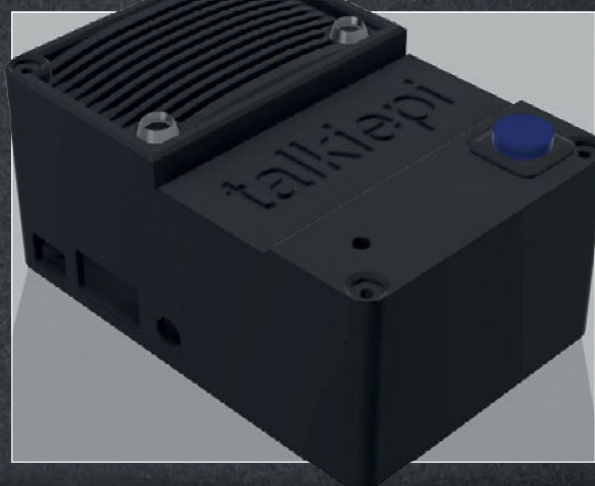
Roger that!



DANIEL CHOTE

Daniel is a believer that everyone can learn new things. If something interests you, there really isn't anything stopping you from attempting to do it yourself.

magpi.cc/2vsqMtx



MAKE YOUR OWN TALKIEPI

SOLDER THE LEADS

Connect the push-button. Solder the status LEDs to wires, and connect those wires via 330 Ω resistors to your GPIO pins. Daniel uses a GPIO header connector.



ADD THE SPEAKER AND MIC

Unscrew the speakerphone. Connect a right-angled mini USB cable to the Pi's USB port. Use it to connect the speakerphone's circuit board to the Raspberry Pi.



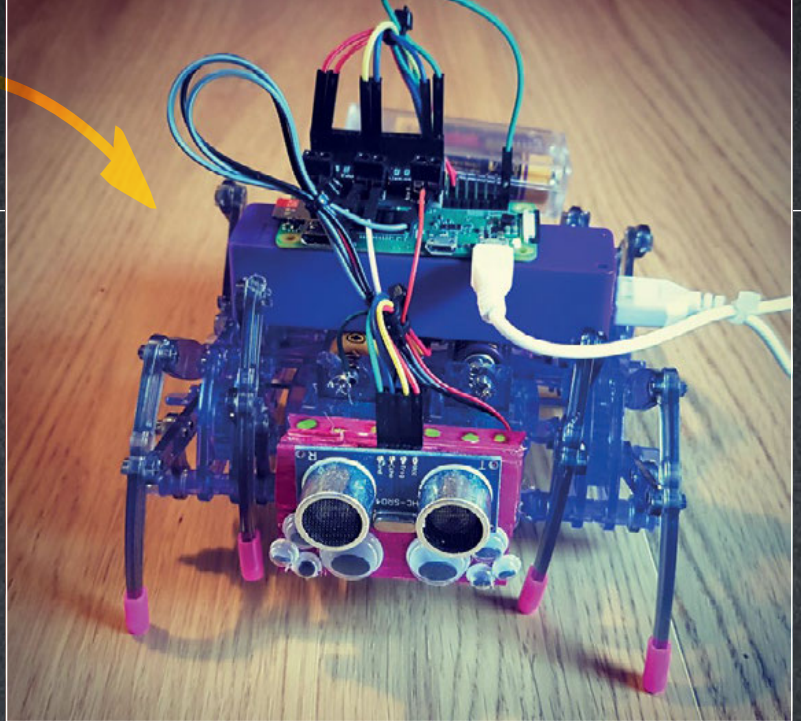
MAKE A CASE

You can 3D-print Daniel's design. If you don't have a 3D printer, you can make your own case from cardboard or LEGO, or use the project without a case.



MAKE A ROBOT

MAKE A ROBOT IN A WEEKEND, WHETHER YOU'RE MAKING YOUR FIRST OR ADDING TO YOUR ARMY



When Mark Norwood saw a £5 spider robot toy in Tiger, he thought: "That would make a great Raspberry Pi project for someone! Hey, that someone could be me!"

The toys scuttle forwards when the power is on, but now Mark has joined

two of the toys together to create a spider that can walk forwards and backwards, under the control of a Raspberry Pi. The robot, Mr Nancy, uses the right legs from one toy and the left legs from another, so they can be controlled independently.

The robot is based on the Raspberry Pi Zero W. Mark uses parts from the CamJam EduKit 3, which provides everything you need to make a simple robot – in particular the motor controller board which enables the Pi to control the motors. The Raspberry Pi is powered using a power pack from Poundland, while four AA batteries drive the legs.

For the software, Mark used a combination of Scratch for line-following, and Python for the distance sensor and obstacle avoidance. He uses RealVNC on

his Chromebook to view the user interface running on the Pi Zero.

This is Mark's second robot based on the CamJam EduKit 3, following his Robocroc which motorised a plastic shoe. "The kit is cheap, and has everything you need, with good instructions on the CamJam site," he says. "Everyone in the community knows it, so they can give you help if you need it."

He found the GPIO Zero examples on the Raspberry Pi website helpful, and his advice to others building robots is to "dabble with GPIO Zero, because it massively reduces the amount of coding you have to do."

Mark's website includes a detailed photo essay showing the construction of Mr Nancy, and you can find out more about the CamJam kit at magpi.cc/2xxxPy8X.

MARK NORWOOD



Mark Norwood is a teacher working in Bedfordshire, specialising in teaching young people with behaviour problems. In his spare time he walks, he dreams, and is a Cub Scout Leader.

magpi.cc/2vsnhDs

BUILD YOUR OWN ROBOT

CHOOSE YOUR CHASSIS

Mark used two of these spider toys for Mr Nancy, but you could build a robot using a pencil case, a cereal box, or a LEGO design.



ADD THE MOTOR BOARD

The motor controller board from the CamJam kit sits on your Pi's GPIO pins. Wire your motors into the left and right terminal blocks, and your motor battery to the middle block.



ADD ADDITIONAL SENSORS

This distance sensor comes from the CamJam kit, and a line-following sensor is also included. Use the CamJam software to test them and add them to your robot.



TRIGGER YOUR THEME SONG

WITH DOORJAM

MAKE YOUR FIRST IMPRESSION COUNT BY TRIGGERING YOUR THEME SONG AS YOU ENTER THE ROOM

As you walk through the door, the bass starts pumping and all heads turn to look. You're here, so it's time to get the party started!

You're using Doorjam, which triggers your theme song as you enter the room. It works like this: a Raspberry Pi 2 emits a Bluetooth Low Energy iBeacon signal, which can be detected by an iPhone. The

Bleno Node package enables a USB Bluetooth dongle to act as an iBeacon.

On the phone, an app detects the iBeacon and sends a signal to a control server containing the Spotify ID of the user's song, and the ID of the iBeacon that has been found. The server uses Node.js to push a command to the Pi to tell it to play the music. Having the server means that you can use the setup to coordinate a whole network of iBeacons across your building or town.

"Bluetooth beacon ranging is notoriously jumpy," says Matt Reed, who made the project. "An app may think you're between three and ten metres away from a beacon at any given second. The Bluetooth received signal strength indicator (RSSI) value is affected by obstacles and other radio interference. I overcame this by using an easing



MATT REED

Matt Reed is a creative technologist at agency redpepper. magpi.cc/2wisSL6

equation to smooth the distance approximation to the beacon. This slows down the detection but makes it more accurate, because you're not out in the parking lot while your theme song is playing inside."

This weekend project is best suited to those with some Node.js experience, but Matt's blog includes essential code snippets for the Pi and the phone.

What is Matt's choice of tune? "I'm on a Boat by Lonely Island Boys," he says. "Don't ask me why, I just love that song and it makes me laugh every time."

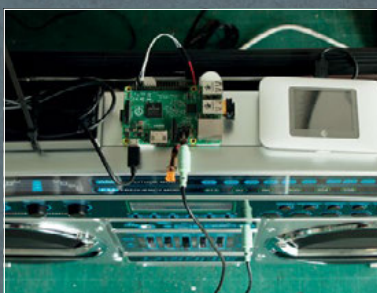
What will your tune be?



MAKE YOUR OWN DOORJAM

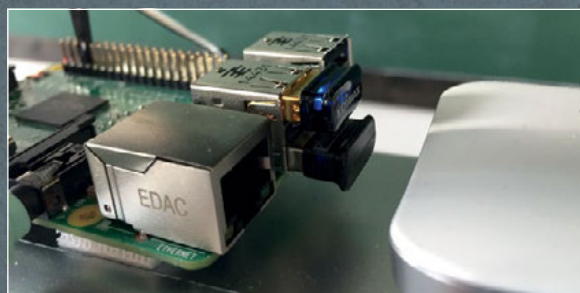
CONNECT THE PI

The Pi's audio out goes to the boombox's audio in. A power supply (left) and 4G hotspot (right) on the top enable the unit to work anywhere.



CONNECT BLUETOOTH AND WIFI

Matt used a Raspberry Pi 2 because he had one handy, so he added dongles for wireless and Bluetooth connectivity. You might prefer to simplify the project by using a Pi 3 with wireless and Bluetooth connectivity built in.



MAKE YOUR TRIGGER

The app (built using PhoneGap) enables users to look up the ID of their Spotify song, and tracks the distance to the iBeacon when it is detected. At less than 10 ft (3 m), it cues the music.



6 EPIC WEEKEND PROJECTS

MORE IDEAS TO ROUND OFF YOUR WEEKEND IN STYLE

PIX-E GIF CAMERA

Nick Brewer and his wife Shayna designed a Pi Zero camera for recording animated GIFs. The power comes from a LiPo battery connected to a PowerBoost 500C to boost its output to 5 V. A button connected to the GPIO is used to trigger the photo, and an LED lights up while the GIF is being recorded. The camera has a 3D-printed case design, and printable paper wrap-arounds to make it feel like a disposable film camera.

magpi.cc/2vuEBaK



PI TOTE

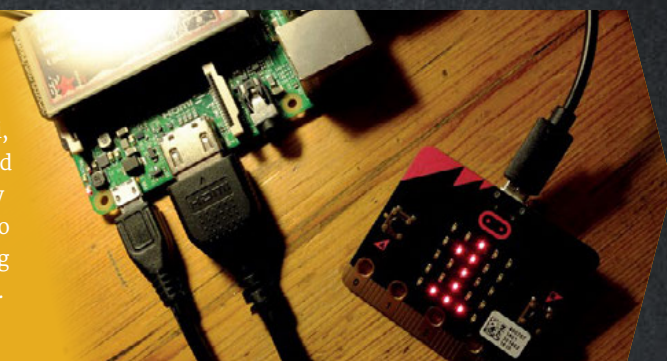
Amanda Haughs designed a tote bag with a Pi Zero concealed in a pocket. It controls seven 5 mm clear white LEDs in the embroidered Raspberry Pi logo, which light up in a random order. 8-inch female-to-female jumper cables are used to connect the LEDs to the Pi and resistors. Amanda used GPIO Zero to pulse the lights, and a cell battery for power. The **rc.local** file was edited so that the program runs when the Pi boots.

magpi.cc/2vrVIKB

MICRO:BIT-CONTROLLED RADIO

Giles Booth made a radio controlled by a BBC micro:bit, using the buttons to change stations and the tilt control for volume. The micro:bit also displays the station number. Giles used David Whale's **bitio** Python library

to access the micro:bit from the Pi, and **mpc** and **mpd** to configure and stream the stations. The **os** library is used to send MPC instructions to the command line. See Giles's blog for instructions, code, and a video. magpi.cc/2xNc39m



THE SMART PHONE

Simon Jackson put the Google AIY Projects Voice Kit into a Fisher-Price telephone, creating a more interactive toy for his six-year-old son Owen. The biggest challenge was getting all the components to fit into

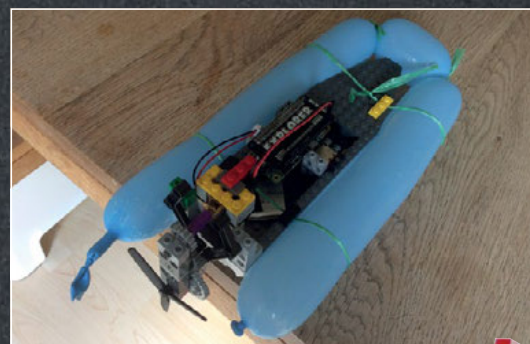
the housing. "I had to source a smaller speaker to save on space. Then the only way I could get the Pi to fit was to cut the rear wheel arches with a soldering iron hot knife tip," he says.

magpi.cc/2es19Sj

LEGO BOAT

Ten-year-old Ozzy Hayler made a Pi-driven LEGO boat, using a balloon for buoyancy. The Pi Zero uses the Explorer pHAT as a motor controller, and it drives a micro metal gearmotor. Power comes from a LiPo battery and LiPo shim. The **remote pins** function of the GPIO Zero library is used to control the Pi from a laptop. "Keep the motor and Pi dry," he advises. "I tested it in a bowl of shallow water first."

magpi.cc/2grYg4l



ARCADE MACHINE

With Lakka and Recalbox in NOOBS, and RetroPie readily available, there are lots of software options if you want to play the games you grew up with. There are several controller options, too: Pimoroni's Picade supports joysticks and arcade buttons, and The Pi Hut makes a SNES-style gamepad. Nate Douglas made this arcade cabinet based on RetroPie using a Pi 3, half-inch medium density fibreboard (MDF), a Samsung 22-inch LED monitor, speakers, and a keyboard.

magpi.cc/2vuCZhc

